Sustainable Regional Development and Planning for Darjeeling District: A Geographical Analysis

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CONSENT OF THE SUPERVISOR

I hereby give my consent to supervise the candidate (**Bappa Hosen**) on the proposed synopsis **Sustainable Regional Development and Planning for Darjeeling District: A Geographical Analysis** leading to a Ph.D degree of the University. I further certify that the synopsis referred to above is to the best of my knowledge and the information has not been published and submitted elsewhere for the award of any diploma or degree.

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Place: Ranchi

Signature of the Supervisor

Sustainable Regional Development and Planning for Darjeeling District: A Geographical Analysis

1. Brief Background & Introduction:

Climate change and diminishing resources have necessitated sustainable development as the goal since the 1990s. Such places like Darjeeling District in West Bengal, India are very important in this regard because of the geographical structure the social-economic setup and the various challenges in form of environmental physical conditions. Darjeeling is an exquisite ecological region that provides indispensable natural resources for millions of people besides being home to precipitous bio-diversity of the Eastern Himalayas. Nevertheless, the district is faced with complicated problems in environmental deterioration, socio-economic disparities, and uncontrolled use of resources in the district, which require an integrated planning and development to be managed through geographic consideration.

The area of Darjeeling District is about 3,149 Sq.Km., and total population according to the census 2011 is 18,38,144. It comprises four subdivisions: Sub-division and four taluks of the Darjeeling district namely Darjeeling Sadar, Kalimpong, Kurseong and Siliguri sub-divisions varying in their socio-economic and enviro-geographical settings. It exhibit various altitudinal gradients including Siliguri plains up to Sandakphu (3636m) thus forming a number of micro-climatic heterogeneity. Geography has a most prominent effect on the use of land, farming practices, and human settlement's distribution. Also famous as the 'Queen of the Hills', Darjeeling has its fame and fold around the world due to controlled tea production that being the main economy of this hilly town. Nevertheless, the district is endowed with good topography and cultural tourism attractions including populated forests, water alongside scenic views of landscapes.A calamity impacting the area within the current decades includes the following; deforestation, landslides, soil erosion and water rationing resulting from climate change. These issues highlight a need for expansive sustainable regional development that meets geographic and socio-economic status of Darjeeling.

Another problem is the mixed and dual growth pattern of Darjeeling District. Large-scale industrialization and infrastructure cannot take root due to steep topography and a very delicate natural environment Factors that have left the economy very vulnerable include reliance on monoculture such as tea. Furthermore, how the large central city of Darjeeling town compares with the rest of the peripheral areas shows the skewed pattern of provision of infrastructure and services including literacy, health facilities and transportation. Sex

and Caste Disparities: The West Bengal Human Development Report (2019) states that the district's HDI is above state average, and that again, the image of good development level is deceptive as it usually depicts intra-district inequality. Landslides are frequent in the region and this adds to the region's developmental challenges. According to the survey conducted by the Geology and Mining department of Haryana and GSI in 2000-2001, about 60% of area falls in high risk landslide prone area of the district. These environmental challenges are further compounded by anthropogenic factors such as; speculative urbanization, over tourism and unhealthy farming. Solving these problems means a reasonable approach to the rational utilization of environmental resources and socio-economic development based on creativity and inclusiveness of urban planning.

Geography offers perspectives that integrate nature-social worlds and hence is pertinent to a developmental approach to Darjeeling's problems. Geographical research involves studying patterns of physical and social environment characteristics, and it is in this way that the researchers reveal the causes of regional disparities and pollution. That is, geospatial analysis may point out patterns with regard to the distribution, allocation, and utilization of resources, land, and people that support sustainable resource management for fair and efficient development. Sustainable development is defined as development that is sustainable to the present generation without cropping the ability of the future generation to meet its needs as was defined in the Brundtland Report (1987). In as much as development is desirable in any context, sustaining Darjeeling requires economic development, ecological, and social balance. Regional sustainable development requires incorporation of environmental, economic and social factors in order to design sustainable regions that can cope with environmental and economic risks.

With the increasing scholarly interest in sustainable development, there is a relative dearth of literature, particularly within the geography discipline, that examines regional planning studies in the context of Darjeeling District. Previous research works are frequently based on a sectoral perspective, and do not take into account interactions between environmental, economic and social issues. This present study intends to fill this gap by adopting a systematic geographical view by incorporating the spatial and geographical perspectives. It aims to study the physical environment, compare development gaps, evaluate the utilisation of resources, and recommend sustainable development profiles that are most appropriate for Darjeeling.

Darjeeling District has inherited a substantial heritage of natural and cultural values, and the challenge facing the region is how to choose the path toward sustainable or, on the contrary, destructive development. Due to its geographical solutions and the ecological value of the region, the applicable strategy of sustainable development of the concerned district should not only accommodate its prospects but distinguish itself from the typical answers to the development question. This research, fundamentally geographically informed, aims at offering advice for the regional policymakers and spatial planners for achieving a harmonious and ripe future for Darjeeling. As such, the study, which combines scientific techniques with participation, seeks to contribute to the general debate on sustainable development and planning in sub-regional areas of mountainous regions.

2. State of the Art:

Sustainable development, its policy of balancing between environmental stewardship, economic growth, and social justice, has received international acceptance since the publication of the Brundtland Report (1987). Thus, sustainable regional development where resource consumption is not an imposition on the regions' ecological status, especially in areas like Darjeeling District is extremely important. The present section surveys the literature and research in light of the study aim and objectives with the intention of establishing research preliminaries.

The physical environment of Darjeeling District gives it its unique geographical features such as Himalayan position, a wide variation in altitude, and fluctuating weather patterns. They pointed the significant level of sensitivity of the options through topographic conditions, geology, and climatic conditions in relation to land utilisation and socio-economic activities. Mukhopadhyay and colleagues found out that the nature of soil in Darjeeling has a high susceptibility of erosion and land slide issues, the risky geophysical conditions owing to steep slopes makes it worst, almost half of the areas are vulnerable to landslides. Likewise, Thakur and Singh (2021) highlighted the effects of microclimate, with special reference to rainfall and agricultural yield pointing out that change of rainfall intensity has increased in last two decades because of climatic change. Interestingly, the use of physical differences has also grown pervasive and popular in the application of geospatial technologies. Mondal and Bandyopadhyay (2020) have employed GIS techniques to generate spatial distribution of landform and to delineate the risk prone zone for natural disasters. Nevertheless, the question of how to link and incorporate socio-economic information together with other physical information for planning the development remains unanswered. This research aims to try and bridge this gap by adopting an integrated geography perspective to assess the physical changes and their consequences on sustainable improvement.

Socio spatial inequalities in Darjeeling are harbingered by health, education and infrastructure which are either lacking or deficient in the rural setting compared to the conducive urban setting. Socio-economic characteristics of the study area Such socio-economic factors all indicated that Darjeeling District is socially sensitive due to disparities in literacy rate, per capita income, and availability of amenities analyzed by Ghosh and Roy (2021). Large and developing cities like Siliguri have apparently received more facility and job facilities than rural districts especially in the high height areas. The MPI data of West Bengal (NITI Aayog, 2021) also inclusive of these—moderate development Darjeeling but with considerable intra-district development difference. Hence, social-cultural exclusion and exploitation of indigenous people such as Gorkhas and Lepchas to the extent that they are locked out from government efforts at welfare provision as pointed out by Chhetri and Lama (2019). Even these studies are useful, the major drawback has been the fact that the analysis has been done in a sectoral manner – either an economic analysis or a social analysis. This study seeks to address these dimensions in a coordinated manner by using quantitative and spatial analysis of the variability of development across the district.

Darjeeling's economy largely remains endowment based and mostly relies on tea gardens, forests, and tourism sectors. But the use of these resources has negatively impacted on the environment through vice such as over exploitation. As stated by Bhattacharya, et al. (2020), the rise in tea gardens has had

implications of land cover change and loss of biophysical features while uncontrolled tourism activities has exerted pressure on water resource and increased production of wastes. Hydro crisis is another challenge well established by Chakraborty et al. (2018) revealing negative trend in water table in the last couple of years. Additionally, forest also provides nearly 38% of the district geographical area (FSI, 2021) where it has exposed to the menace of Illegal logging and encroachment. Lama and Gurung (2022) have suggested community-based natural resource management as a way forward and based on the better involvement of local actors for better practices. Nonetheless, such efforts are hobbled by deficiencies in linkages to comprehensive planning strategies in the overall regions. This research seeks to overcome this research limitation by assessing the level of resource exploitation and identifying ways of improving the implementation of sound strategies of resource management at district levels.

In order to arrange Darjeeling District into particular resources areas, one should consider spatial organization of natural, economical, and human resources. Prior research has paid attention to individual resources only, either as independent variables or as heterogeneous factors assuming that resources are mutually exclusive and interact in vain. For instance, Pradhan et al. (2020) mapped and assessed the spatial extent of agricultural resources where they pointed that high-altitude areas possess poor or restricted Agricultural Production Suitability (APS) because of the unfavorable physical characteristics of the soil and climate. Prospective findings can be seen in the employment of geospatial approaches for resource mapping. Mondal and Bandyopadhyay (2020) also showed how GIS could be implemented to define future areas of eco-tourism and similarly Ghosh and Roy (2021) were able to map health care and education facilities. Nevertheless, limited numbers of the current studies have included integration of the multiple resource dimensions to uncover the resource regions. To fulfil this need, this study aims to use contemporary geospatial tools and community involvement methods to define resource areas, establishing the logical framework for equitable resource distribution and sustainable utilization.

There is a consensus of opinion suggesting that the degree of sustainable development has to be expressed with dimensions that are environmental-social, and economic at the same time. For instance, international guidelines like the Sustainable Development Goals (SDGs) have regional reliability, but adopting them for assessing regional aspirations means adjusting them—an aspect that this paper considers. Das and Ghosh (2022) constructed an academic SDI for the Indian districts setting Darjeeling in a moderate level of environmental sustainability, moderate – low on social equity. This finding is further supported by Bhattacharya et al., (2020) who pointed that Even though Darjeeling district scores well in biodiversity conservation, it is weak in the areas of inclusive economic growth and social development. To these resource contributions, existing studies have not used primary data from field studies or stakeholder consultation in the main, hence their practical use is restricted. This research goes a notch higher to fill this gap by developing sample base measures of sustainable development and incorporating localized views.

Therefore, the sort of regional planning models is useful to tackle development issues and drive sustainability in the community. Various models have been put into practice where models for the context of Darjeeling, models such as the Integrated Development Planning (IDP) framework for instance, exist. Depending on Sharma and Bhattacharya (2021), IDP complies with environmental conservation and socio-economic development, which make it appropriate to the sensitive environments. Geospatial models have

also turned out to be popular and Mondal and Bandyopadhyay (2020) showed how GIS can be used in development of eco-sensitive area. However, these models are rigid and cannot adapt to the local socio-cultural realities, therebyforth, restricting their acceptance. This paper aims at contributing to the enhancement of regional sustainable development models through combining scientific methods with participatory tools. In this way, the planned models are both scientifically sound and take into consideration the opinion of the local community, which is why the goal of the research is to involve the latter in the planning stage.

The peer-reviewed journal articles offer the following germane findings relevant to various aspects of sustainable development and planning in Darjeeling District. Nevertheless, there are still many deficiencies in the application of environmental and socio-economic aspects, in the identification of spatial differences, and in the adaptation of development models to the context. This research aims at filling these gaps by integrating the best geographical practices, sophisticated techniques, and the input of local actors.

3. Problems to be Investigated:

This study will address the following critical problems:

1. What are the spatial variations in the physical setting of Darjeeling District, and how do they impact development?
2. What are the patterns and causes of socio-economic imbalances across the district?
3. To what extent are natural resources being exploited, and what are the environmental consequences?
4. How can resource regions within the district be delineated for optimal planning and management?
5. What is the level of regional sustainable development in the district based on sample studies?
6. What models can be used for the Sustainable Development of The District?

4. The Objective of the Investigation and Motivation:

- **Objectives of the Study:** *This study aims to address the following critical problems:*

1. Analyze spatial variations in the physical setting and their impact on development.
2. Delineate resource regions for better planning and management.
3. Identify patterns of socio-economic imbalances and their underlying causes.
4. Assess the extent and consequences of resource exploitation.
5. Conduct sample studies to measure levels of regional sustainable development.
6. To create applicable sustainable development models for the district.

- **Motivation of the Study:** The motivation for this study arises from the urgent need to address the unique challenges faced by Darjeeling District. As an ecologically sensitive region, Darjeeling

grapples with environmental degradation, resource overexploitation, and socio-economic disparities. The region's reliance on fragile ecosystems for livelihoods, coupled with its vulnerability to natural hazards, demands a comprehensive and sustainable approach to planning. Moreover, existing development strategies often fail to integrate environmental sustainability with socio-economic equity, leaving gaps in policy effectiveness. This research is driven by a commitment to bridging these gaps by applying geographic insights, spatial analyses, and participatory approaches. By aligning with global sustainable development goals, this study aims to contribute actionable solutions for fostering balanced and inclusive growth in Darjeeling.

5. Research Questions & Research Hypothesis:

- ***Research Questions:***

1. How do spatial variations in the physical setting influence development patterns in Darjeeling District?
2. What are the socio-economic imbalances across the district, and what factors contribute to them?
3. To what extent are natural resources in Darjeeling being exploited?
4. How can the district's resource regions be delineated for effective management and planning?
5. What are the indicators of sustainable development in Darjeeling District, and how do they vary regionally?
6. How can models of regional sustainable development be generated and applied to formulate efficient planning in the district?

- ***Research Hypothesis:***

1. Areas with favorable physical setting such as proximity to water sources, moderate slope in the Darjeeling district exhibit higher level of socio economic development compared to areas with less favorable physical settings.
2. Urban areas in Darjeeling district exhibit higher socio economic indicators compared to rural area.
3. Higher levels of natural resource exploitation in Darjeeling district are associated with a decrease in regional environmental sustainability.

6. Research Design & Methodology:

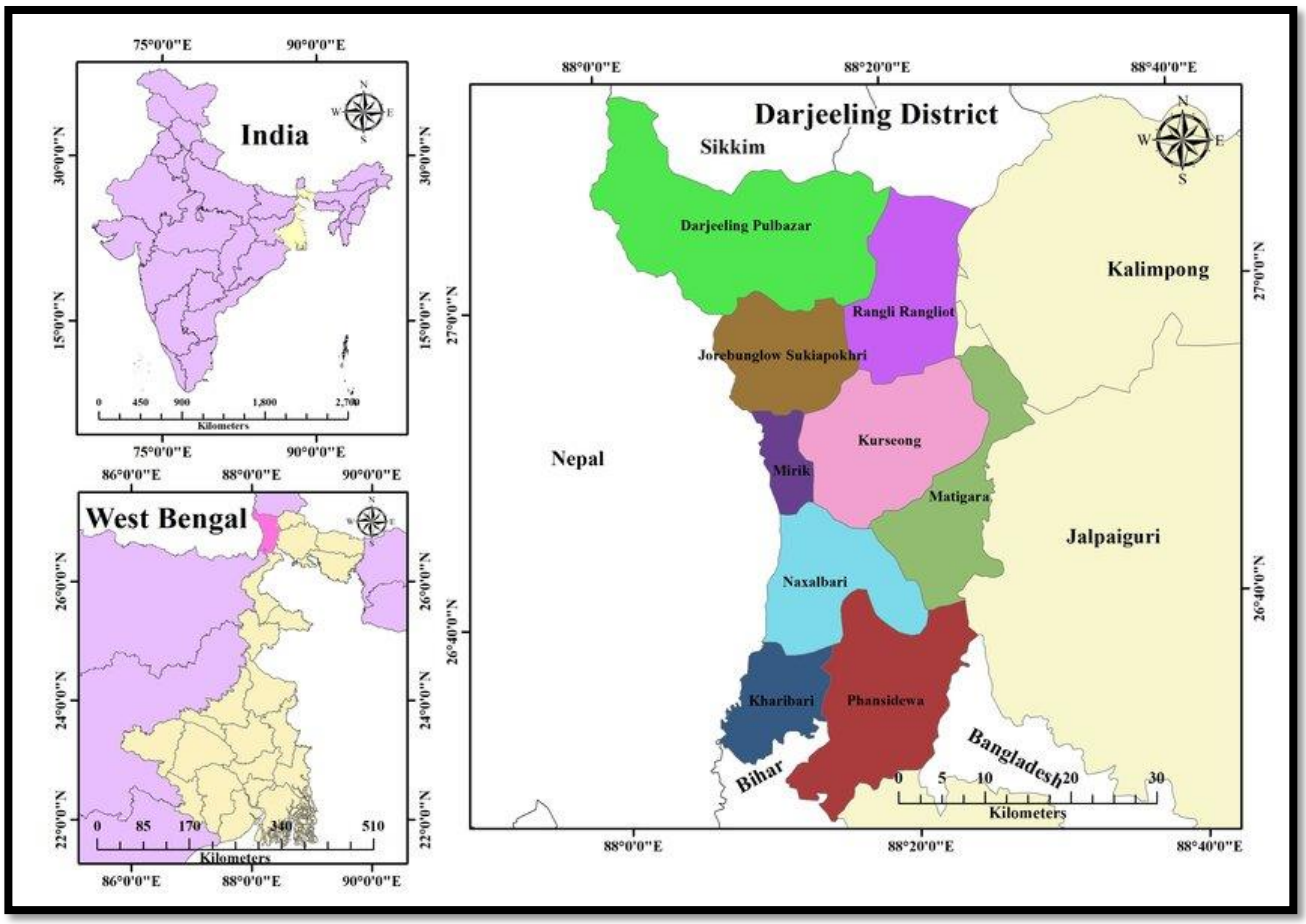
Selection of Field:

The study focuses on Darjeeling District, West Bengal, with its five subdivisions—Darjeeling Sadar, Kalimpong, Kurseong, Mirik, and Siliguri—chosen for their diverse physical, socio-economic, and ecological conditions. The district includes 12 administrative blocks spread across various police stations and gram panchayats (GPs). The recent subdivision data is as follows:

Subdivision	Block	Police Station	Number of GPs
Darjeeling (Sadar)	Darjeeling-Pulbazar	Darjeeling (Sadar)	23
Darjeeling (Sadar)	Darjeeling-Pulbazar	Pulbazar	23
Darjeeling (Sadar)	Darjeeling-Pulbazar	Lodhama	23
Darjeeling (Sadar)	Rangli-Rangliot	Rangli-Rangliot	11
Darjeeling (Sadar)	Jorebunglow-Sukhiapokharii	Jorebunglow	16
Darjeeling (Sadar)	Jorebunglow-Sukhiapokharii	Sukhiapokharii	16
Kurseong	Kurseong	Kurseong	14
Mirik	Mirik	Mirik	6
Siliguri	Matigara	Siliguri	5
Siliguri	Matigara	Matigara	5
Siliguri	Naxalbari	Bagdogra	6
Siliguri	Naxalbari	Naxalbari	6
Siliguri	Khoribari	Khoribari	4
Siliguri	Phansidewa	Phansidewa	7

This diverse geographic and administrative setup provides a robust framework for analyzing physical, socio-economic, and resource-based variations within the district.

- **Study Area Map**



Methodology:

Pre-field Activities

1. **Literature Review**: Review existing studies, government documents, and reports on in Darjeeling.
2. **Data Collection**: Compile secondary data, including maps, satellite images, census data, and administrative records.
3. **Planning**: and finalize key indicators, and prepare field instruments such as questionnaires and GIS tools.

Sample Design

1. **Sampling Frame**: Include both rural and urban samples.
2. **Sample Selection**: Stratified random sampling to ensure representation of all blocks and subdivisions.
3. **Sample Size**: Approximately 150 individuals divided equally across the resource regions will be selected for household surveys, focus groups, and stakeholder interviews.

Data Collection Strategy

1. **Primary Data**:
    - Household surveys to assess resource utilization and socio-economic conditions.
    - Interviews with local administrators, planners, and community leaders.
    - Focus group discussions with farmers, workers, and marginalized groups.
2. **Secondary Data**:
    - District statistical handbooks, reports on land use, and environmental data from government departments.
    - Spatial data from GIS and satellite imagery.

Field Visits

Field visits will focus on collecting data from selected gram panchayats in each subdivision. Observations on environmental conditions, resource utilization, and development infrastructure will be recorded.

Data Analysis

1. **Spatial Analysis**:
    - GIS-based mapping of resource regions, development imbalances, and physical variations.
2. **Statistical Analysis**:
    - Use of statistical techniques such as regression and ANOVA to analyze socio-economic and environmental data.
3. **Qualitative Analysis**:
    - Thematic analysis of interviews and focus group data to identify patterns and insights.

Interpretation and Reporting

Findings will be synthesized to address the research questions and objectives. Detailed maps, graphs, and narratives will be included to support interpretations. Recommendations for sustainable development planning will be developed and reported systematically for policymakers and stakeholders.

- **Tentative Chapterization of the Thesis:**

Introduction

Chapter 1: Physical Setting and Natural Resources of Darjeeling District

Chapter 2: Socio-Economic Structure and Development Patterns

Chapter 3: Resource Utilization and Environmental Impacts

Chapter 4: Delimitation of Resource Regions

Chapter 5: Measuring Regional Sustainable Development

Chapter 6: Creation and application of models for development of District

Case Studies

Conclusion

Bibliography

Appendix

7. Sources of Data and Tools to Be Used in the Collection of Data:

- **Sources of Data:**

1. **Primary Data**:
    - Household surveys to gather socio-economic and resource utilization information.
    - Focus group discussions with local stakeholders (farmers, administrators, and community members).
    - Interviews with policymakers, planners, and local government officials.
2. **Secondary Data**:
    - Census reports and district statistical handbooks for demographic and economic data.
    - Environmental reports and resource data from government departments (e.g., Forest Department, Department of Land Reforms).

- Satellite imagery and maps from agencies like ISRO, NRSC, and Survey of India.
- Relevant academic research papers, books, and policy documents.

3. **Tools to Be Used:**

1. **For Data Collection**:
   - Structured and semi-structured questionnaires for surveys and interviews.
   - Audio recorders and note-taking tools for qualitative data collection during interviews and discussions.
   - GPS devices for spatial data collection and field observations.
2. **For Data Analysis**:
   - **GIS Tools**: For mapping and spatial analysis of resource regions and development patterns.
   - **Statistical Software**: Tools like SPSS or R for statistical analysis of socio-economic and environmental data.
   - **Thematic Analysis**: For qualitative data interpretation from interviews and focus groups.

8. Analysis of Data:

The analysis of data will be carried out using a combination of quantitative and qualitative methods to address the study's objectives effectively:

- **Quantitative Analysis**

1. **Statistical Techniques**:
   - Descriptive statistics to summarize socio-economic and environmental data.
   - Inferential statistics (e.g., regression analysis, ANOVA) to identify patterns and relationships between variables.
2. **GIS-Based Spatial Analysis**:
   - Mapping of physical settings, resource regions, and development imbalances.
   - Spatial overlays to analyze the relationship between geographic features and socio-economic development.

- Qualitative Analysis

1. **Thematic Analysis**:
   - Interpretation of data from interviews and focus group discussions to understand stakeholders' perspectives.
   - Identification of recurring themes related to sustainable development challenges and opportunities.

- **Comparative Analysis**

- Cross-sectional comparison of sampled gram panchayats to assess regional disparities in resource utilization and development.

- **Synthesis of Results**

- Integration of quantitative and qualitative findings to provide a comprehensive understanding of regional sustainable development in Darjeeling District.

9. Significance of the Study:

The study is important in that it is likely to contribute to the solution of major issues in sustainable development and resource use in the Darjeeling District. It elucidates the inequalities in regional development aasis and patterns of resource exploitation for assistance for policymakers and planners in formulating policies that will ensure proper and sustainable development. The research outcomes would address these needs by informing the constructive use of natural resources while enhancing the social and economic development of the district that will protect the delicate ecological system. Furthermore, by integrating and analyzing indices of sustainable development in relation to models of sustainable development, the study presents region planning strategies that guarantee that the ecological balance will be maintained in the long-term alongside improvements to the quality of life for the inhabitants. The purpose of this study also relates to filling gaps observed in literature and thus conduces to evidence-based decision making for the attainment of the concomitant developmental objectives in the region.

10. Relation to modern issues and concerns of society:

This research concerns several current problems concerning society, especially those areas that are ecologically sensitive, such as the Darjeeling District. It addresses the increasing concern of the call for sustainable development by addressing issues like degradation of environment, social/economic inequality and irrational exploitation of resources. Given the focus on climate change worsening the region's weaknesses in various areas, the study targeted formulation of ways of addressing the effects of climate change as well as fostering sustainable development in the region. The findings are also useful in interrogating the question of how to achieve a vibrant and harmonious rural-urban interface; equitable and sustainable economic development; and positive social and economic transformation among vulnerable groups. Moreover, by presenting the grassroots to policymaking strategies and feasible planning approaches, the research complies with trends such as the United Nations' sustainable goals 2030 and the state of India that aims at region sustainability.

11. Strengthening of Knowledge in the Existing Domain:

Insignificant with sustainable regional development, specifically in geographically boosted and environmentally precious areas like Darjeeling District, this study provides following noteworthy contributions to theoretical database. It gives systematic geographical reconnaissance of uneven development, resource exploitation and social-economic inequalities thus providing fresh perspectives of the interrelated phenomenon. The research presents novel contributions to the practical adaptations of sustainable development models appropriate to the physical and social environments of the region, filling the gaps in the existing literature. The combination of GIS-based spatial analysis and qualitative methods

improves innovative methodological frameworks for regional planning. Moreover, it helps in policy making with regard to options for developing sustainable policies that would open up society's sustainability in the hilly terrain without compromising on the forests and environment, which enhances the knowledge base both within the academic and applied fields regarding development that is sustainable in the geographical context of hilly terrains.

12. Future Work: Future Research Could Explore:

Future research could expand on the findings of this study by exploring several key areas for further development and understanding. One potential avenue is the long-term impacts of climate change on resource availability and agricultural productivity in Darjeeling, particularly how changing weather patterns may exacerbate existing development imbalances. Additionally, research could delve deeper into the role of indigenous knowledge systems in promoting sustainable resource management and adaptation strategies in rural communities. Further studies could also explore the effectiveness of integrating technology, such as remote sensing and AI-based models, in monitoring and managing sustainable development practices. Comparative studies between Darjeeling and other similar hilly regions in India or globally could offer broader insights into the applicability of sustainable development models across diverse landscapes. Lastly, exploring the social dimensions of sustainability, particularly how gender and caste influence access to resources and development opportunities, would help provide a more inclusive framework for regional planning and policy-making.

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